SPACE CENTER
# Roundup

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# Additional safety checks delay next shuttle launch

Following an electrical short experienced during the launch of *Columbia* on STS-93 in July, space shuttle managers have initiated comprehensive inspections and repairs of the shuttle's electrical wiring and have delayed launch of the next mission, now planned to be STS-103 to service the Hubble Space Telescope, to no earlier than November 19.

As a result of the damaged wire in *Columbia* and subsequent inspections that found additional damaged wires in *Discovery* and *Endeavour*, managers have developed a plan that includes inspecting and repairing more than 100 miles of wiring in each shuttle orbiter. Because the inspection and repair work has progressed more quickly on *Discovery* than on *Endeavour*, *Discovery*'s flight to the Hubble Space Telescope on STS-103 has replaced *Endeavour*'s flight on STS-99 as the next mission, said Space Shuttle Program Manager Ron Dittemore.

As of late September, however, managers were still preserving the option of launching STS-99, the Space Radar Topography Mission, before the end of the year, although it appeared unlikely that *Endeavour* could be ready for launch before early December.

Shuttle wiring inspections have been under way since early August because of a problem experienced by *Columbia* during STS-93. On July 20, five seconds into the flight, an electrical short circuit interrupted power to computer controllers for two of the shuttle's three main engines. Backup controllers immediately began operating as designed, however, and there was no impact on the mission. Technicians later traced the problem to a wire whose insulation had been damaged, exposing the wire conductor, which subsequently shorted when it touched a metal screw head.

"The team working on these inspections and repairs has included people here at JSC and at the Kennedy Space Center and personnel from both United Space Alliance and NASA," Dittemore said. "This has been a very complex problem and it has involved a great deal of very focused, often tedious, work. The team has just done an excellent job tackling this issue and keeping the safety of the shuttle at the forefront every day."

At press time, inspections of *Discovery* were nearing completion and the repairs were progressing well. The work on *Endeavour* was about two weeks behind that being performed on *Discovery*, and inspections of *Atlantis* had just begun as it was moved into the third shuttle hangar at KSC. That hangar was vacated September 24 by *Columbia* as it was ferried to Palmdale, Ca., to begin a 10 month maintenance and modification period. *Columbia* will be inspected and repaired during its stay in California.

The inspectors will examine about half the electrical wiring in each shuttle by the time they are finished. In addition to the repair of damaged wiring, technicians are adding protection against future problems. These steps include encasing some wires in plastic tubing and adding Teflon wrapping to others. In addition to adding wire protection, technicians are removing any burrs or sharp edges on fasteners which could potentially damage wires.

"To prevent a recurrence of damage, we are placing convoluted tubing around wire bundles in the most likely areas to be damaged," Dittemore said. This will protect the wires against sharp edges and fasteners so that there will be no likelihood in the future that a bundle of wires will touch these areas.

Although the original design of the shuttle precludes the situation in most areas, technicians also are separating wires that serve the same function from the same bundle. That way damage to one area cannot knock out primary and backup wires that perform the same function such as those used for the computer controllers.

In addition to performing inspections and repairs and looking at design redundancy, technicians are testing wires, exposing conductors on side-by-side wires and vibrating them, exposing conductors to sharp edges and metal plates, to see how sensitive they are to damage and to shorts. The objective is to understand the potential of wires to short. Testing has shown that the wires don't short easily.

"We don't plan to inspect every wire but we will have inspected enough wires to feel confident that we will be safe because, where feasible, we are putting critical functions in different bundles, we are protecting the bundles and, once protection is in place, the probability of an electrical short due to wire damage is very low," said Dittemore. "Adding these three things together will put us in a good position to go fly."

In addition to reviewing the wiring of the orbiters, shuttle managers and technicians have looked at the solid rocket motors, boosters, the external tank and the main engines to gauge if the wiring in those components is susceptible to damage. The reviews also have included crew equipment, spacesuits and ground support equipment at the launch site. Those reviews have found that the wiring in most components was well-protected and that there was no reason to suspect they may have suffered damage similar to that found on the orbiters.

Dittemore said that all the wiring problems appear to have been caused by work-induced mechanical damage that stemmed from the wires being rubbed or stepped on, or from heavy objects set down on them. None of the problems are related to age of the wiring, normal wear or vibration from shuttle operations.

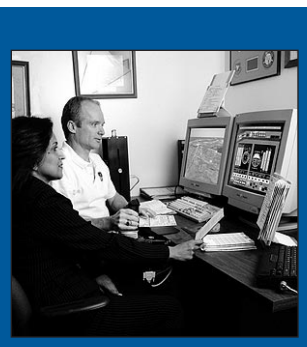
"We have to be sensitive about working around these wires," said Dittemore. "We have to have a heightened awareness of what can happen in the work area. Everywhere we're developing hardware, we need to look at our practices and make sure that we're not inducing damage."

Future remedies being reviewed include changes in work rules to prevent inadvertent wire damage by workers, changes in work platforms to prevent people or tools from touching certain parts of the orbiter, and the addition of more detailed wire inspections to the processing flow that each shuttle undergoes between flights. ■

> ***We are looking at all aspects of the program, alerting each organization that wire damage can occur just by working in the areas where wires are located.***
>
> – Ron Dittemore

NASA KSC-99PD-812-04

**KENNEDY SPACE CENTER, FLORIDA – A wire damaged by abrasion from the head of a screw (seen below the bundle) was found during electrical wiring inspections in *Columbia*'s payload bay. During launch of *Columbia* on mission STS-93, a damaged wire caused a short circuit in two separate main engine controllers.**



Desktop shuttle simulator improves training.

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Come rain or come shine, the day will be fine.

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Oven fresh pizza delivered to your door.

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